

GROUND BEETLES OF NANTUCKET ISLAND, MASSACHUSETTS: 1995 (COLEOPTERA: CARABIDAE)

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Abstract.—A single season (1995) of ground beetle collecting on Nantucket Island, Massachusetts yielded 102 species in 18 tribes (Coleoptera: Carabidae). Fifty-seven species not previously recorded from the island were taken, including five species not currently listed for Massachusetts. Globally rare habitats including Maritime Heath/Grasslands, Morainal Frost Bottoms and Coastal Plain Ponds were intensively assayed. A high species turnover rate is implied by this preliminary analysis.

The eastern United States has been surveyed for insects since the early nineteenth century. Throughout this region, the ground beetle fauna is generally very well known, but Nantucket Island, Martha's Vineyard and the Elizabeth Islands off Massachusetts south of Cape Cod in particular seem to have been especially neglected by entomologists, as measured by published research, due at least in part to their relative inaccessibility. Their isolation coupled with rarity of the maritime sandplain habitats developed there ironically makes these islands especially likely to contain unique assemblages of carabids, as well as species that may be rare elsewhere. Modern floristic studies on the islands present corresponding parallels (Peter W. Dunwiddie, pers. comm.).

This report provides a checklist (Table 1) of 102 ground beetles that presently occur on Nantucket Island. Collections were made from early May to mid-September 1995, principally with pitfall traps containing propylene glycol-based preservative, using standard techniques. Voucher specimens are held at the Sandplains Bioreserve office of The Nature Conservancy, Vineyard Haven, Massachusetts.

Several special island habitats, unique for their floristics, geology, hydrology and/or microclimate, were singled out for intensive study, including the following sites, accounting for the large majority of ground beetle species collected in 1995:

Miacomet Plains Maritime Heath/Grassland: near coastal sand dunes at southern end of Somerset Road; flat open terrain with scattered pitch pine, arrowwood copses and black cherry; also present: dwarf blueberry, huckleberry, *Rubus*, *Rosa*, *Baptisia*, *Carex*, trailing arbutus, bearberry, bracken fern, dense foliose lichen, and such old field seral forb types as milkweed, wood lily, thistle and *Solidago*. Morning fog, salt spray from the nearby south coast surf, lower ambient temperatures (relative to Nantucket town) and frequent sand-bearing onshore winds also define this habitat; an approximately 10 day lag in floral phenology compared with the town was apparent.

Oak Barrens: xeric site west of Sankaty Head in the east central moors south of the Barnard Valley Road, dominated by thickets of mixed *ilicifolia/prinoides* scrub oaks (*Quercus*). In late May 1995 a profound frost here killed much foliage and twigs. Other plants include *Rubus*, arrowwood, huckleberry, *Carex* and grasses.

Table 1. Ground beetles (Coleoptera: Carabidae) collected on Nantucket Island in 1995. Tribes and genera in phylogenetic sequence (basal to derived), from Bousquet and Larochelle (1993); species listed alphabetically, noting European introductions.

Ground Beetle Taxa		in Johnson (1930)
Notiophilini		
Notiophilus nemoralis Fall		
Notiophilus semistriatus Say		
Loricerini		
Loricera pilicornis (F.)		
Cicindelini		
Cicindela hirticollis Say		*
Cicindela punctulata Olivier		*
Cicindela repanda Dejean		*
Cicindela sexguttata F.		*
Carabini		
Calosoma calidum F.		*
Carabus nemoralis Müller		*
Cychrini		
Sphaeroderus stenostomus lecontei Dejean		
Omophronini		
Omophron americanum Dejean		*
Omophron tessellatum Say		*
Brachinini		
Brachinus cyanipennis Say		*
Brachinus fulminatus Erwin		
Brachinus janthinipennis (Dejean)		
Brachinus medius Harris		
Clivinini		
Dyschirius integer LeConte		
Dyschirius setosus LeConte		
Clivina americana Dejean		
Clivina bipustulata (F.)		
Bembidiini		

INTRODUCED

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Table 1. Continued.

Ground Beetle Taxa	in Johnson (1930)
Bembidion confusum Hayward	
Bembidion constrictum (LeConte)	
Bembidion contractum Say	*
Bembidion frontale (LeConte)	
Bembidion impotens Casey	
Bembidion minus Hayward	
Bembidion patrule Dejean	*
Bembidion rapidum (LeConte)	
Bembidion transparens (Gebler)	
Bembidion versicolor (LeConte)	
Elaphropus incurvus (Say)	*
Elaphropus xanthopus (Dejean)	
Patrobini	
Patrobis longicornis (Say)	*
Pterostichini	
Poecilus lucublandus (Say)	*
Pterostichus commutabilis (Motschulsky)	*
Pterostichus corvinus (Dejean)	*
Pterostichus luctuosus (Dejean)	*
Pterostichus melanarius (Illiger)	*
Pterostichus mutus (Say)	*
Pterostichus patruelis (Dejean)	*
Zabrinii	
Amara aenea (DeGeer)	
Amara chalcea Dejean	
Amara convexa LeConte	
Amara littoralis Mannerheim	
Amara lunicollis Schiodte	
Amara quenseli (Schönherr)	
Oodini	
NEW RECORD FOR MASSACHUSETTS	
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Table 1. Continued.

Ground Beetle Taxa	in Johnson (1930)
Oodes amaroides Dejean	*
Chlaeniini	
Chlaenius pennsylvanicus Say	*
Chlaenius sericeus (Forster)	*
Chlaenius tricolor Dejean	*
Licinini	
Dicaelus elongatus Bonelli	*
Diplocheila obtusa (LeConte)	
Badister notatus Haldeman	
Harpalini	
Notiobia terminata (Say)	
Anisodactylus harrisii LeConte	*
Anisodactylus nigririmus (Dejean)	*
Anisodactylus rusticus (Say)	*
Anisodactylus sanctaecrucis (F)	
Amphasia sericea (Harris)	
Stenolophus conjunctus (Say)	*
Stenolophus fuliginosus Dejean	
Stenolophus lineola (F)	
Stenolophus megacephalus Lindroth	
Stenolophus ochropezus (Say)	*
Stenolophus plebejus Dejean	*
Bradycellus congener (LeConte)	
Bradycellus lecontei Csiki	
Bradycellus nigriceps LeConte	
Bradycellus rupestris (Say)	
Bradycellus tantillus (Dejean)	
Acupalpus nanellus Casey	
Acupalpus pumilus Lindroth	
Harpalus affinis (Schrank)	*
NEW RECORD FOR MASSACHUSETTS	
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INTRODUCED	

Table 1. Continued.

Ground Beetle Taxa	in Johnson (1930)
Harpalus compar LeConte	*
Harpalus pensylvanicus (DeGeer)	*
Harpalus puncticeps (Stephens)	
Harpalus rufipes (DeGeer)	
Harpalus somnulentus Dejean	
Selenophorus ellipticus Dejean	*
Platynini	
Calathus opaculus LeConte	
Synuchus impunctatus (Say)	
Oxypselaphus pusillus (LeConte)	*
Agonum aeruginosum Dejean	
Agonum darlingtoni Lindroth	
Agonum decorum (Say)	
Agonum fidele Casey	*
Agonum gratosum (Mannerheim)	*
Agonum lutulentum (LeConte)	*
Agonum melanarium Dejean	*
Agonum mutatum (Gemminger & Harold)	*
Agonum retracts LeConte	*
Agonum tenue (LeConte)	*
Platynus cincticollis (Say)	*
Platynus decentis (Say)	*
Lebiini	
Cymindis americanus Dejean	
Cymindis cribricollis Dejean	
Cymindis neglectus Haldeman	
Cymindis pilosus Say	
Cymindis platicollis (Say)	*
Apenes sinuatus (Say)	
Axinopalpus bplagiatus (Dejean)	
Syntomus americanus (Dejean)	*

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NEW RECORD FOR MASSACHUSETTS

Coastal Plain Ponds: a cluster of three small permanent kettle ponds ca. 1 km southwest of Sachacha Pond in the central moors, with characteristic broad sparsely vegetated sandy-mud beach and declining water levels throughout the summer. Rolling terrain dominated by dense scrub oak, *Smilax* and northern arrowwood thickets, the upper beach perimeter dominated by high bush blueberry, *Kalmia*, *Clethra*, black huckleberry (*Gaylussacia baccata*), dangleberry (*G. frondosa*), *Spirea* and *Cyperus*, with *Xyris* and several *Drosera*, low grasses and sedges colonizing the broad open beach.

Frost Bottom: small deep depression in gently rolling terrain of central moors adjacent to the Oak Barrens trapping site; this area was also affected by the hard frost of late May 1995. [Frost bottoms on Nantucket are small depressions in the morainal landscape of the central moors; they drain air poorly and undergo large temperature swings including occasional midsummer frost events (Alan Rinehart, pers. comm.)]. In May this site contained a shallow lens of water that had disappeared by 4 July. Characteristic plants include several ferns, *Scirpus*, other sedges and grasses, *Rubus*, *Sphagnum*, sweet fern, bayberry, bluet, bearberry, beach plum, dwarf blueberry, bird's-foot violet, trailing arbutus and scattered scrub oaks.

In addition to these special sites, ground beetles were taken at many other island locations. Particularly productive in terms of diversity or noteworthy for uniqueness were the following sites: xeric juniper/arrowwood/grape shrub thickets at Nantucket Field Station (University of Massachusetts) east of Folgers Marsh in Quaise north of the Polpis Road, sandy south beach of Maxcys Pond, Head of Hummock Pond, the Polpis Road cranberry bogs, Masquetuck along the west shoreline of Polpis Harbor, sloughs behind rear dunes at Fishers Landing by the Eel Point Road and the south shore of brackish Sachacha Pond [Note: this conservative spelling of the well-known pond is taken from the *Historical Map of Nantucket*, surveyed and drawn in 1869 by Rev. F. C. Ewer, D. D. and published by the Old Colony R. R. Line in 1877, that labels the pond and nearby village of Sachacha without the gratuitous emendation of an added silent initial syllable as used on some recent maps; Johnson (1930) and his editors at the Nantucket Maria Mitchell Association also used this spelling].

DISCUSSION

A season of field collecting in 1995 on Nantucket Island revealed 102 ground beetle species including five that constitute new records for Massachusetts (Bousquet and Laroche, 1993). These five are *Clivina bipustulata* (F.), *Bembidion impotens* Casey, *Bradycellus tantillus* (Dejean), *Acupalpus nanellus* Casey and *Apenes sinuatus* (Say). Fifty-seven of the species found are new records for this island, pointing to the likelihood that more fieldwork on the islands off southeastern Massachusetts, straddling one of the major Atlantic biotic transition zones, will provide important new biogeographical information on carabids. Ancillary collections of ground beetles in 1995 on Marthas Vineyard and on Naushon (Elizabeth Islands) by The Nature Conservancy yielded species, some common, that apparently do not exist on Nantucket.

Charles Willison Johnson, who curated insects and mollusks for the Boston Society of Natural History, intermittently collected carabid beetles and other insects on

Nantucket in the 1920's, adding his records to others made there before and since the turn of the century in a checklist (Johnson, 1930) which included about 84 ground beetle species, a few still represented by voucher specimens housed at the Nantucket Maria Mitchell Association on Vestal Street. His list provides a view into island post-agricultural habitat states preceding the next era of profound ecological alterations that accompanied development, a ground beetle necrocoenose.

MacArthur and Wilson's (1967) keystone work on island biogeography outlines a theory of immigration and extinction rates reaching toward dynamic equilibrium (balanced turnover) as available niches are exploited, vacated and re-filled. Held in the light of the present 1995 accounting, Johnson's list gives the impression of a very high species turnover rate: in about 75 years half the 84 species he reported seem to have disappeared, and of today's 1995 list half the 102 carabid species are new. This evidently high turnover rate may result in part from the enhanced immigration potential from increasingly frequent maritime and airport arrivals. Immigrant taxa most likely are principally drawn from staging areas with environments not unlike Nantucket, arriving on aircraft that departed New Jersey, Long Island, Boston and Hyannis. Surface arrivals have similar origins, mostly via autos funneled through the Hyannis ferryhead. In this way austral faunal elements as well as boreal have had continued access to the island.

Present-day patterns of ground beetle distribution on Nantucket Island conform with expectations leading from previous studies (e.g., Will *et al.*, 1995; Purrington and Horn, 1994; Paoletti *et al.*, 1991; Purrington *et al.*, 1989), with certain exceptions. *Dicaelus elongatus* was not anticipated at the Miacomet Plains since it is a typically forest species elsewhere. Frequent coastal fog, combined with the evergreen character of the many heathland plants at this site, may account for its seemingly anomalous presence. Other carabids found at Miacomet also suggest the uniqueness of that habitat. For example, both *Clivina bipustulata* and *Apenes sinuatus* occurred there although neither has been previously recorded from Massachusetts (Bousquet and Laroche, 1993). The only large caterpillar hunter remaining on the island, *Calosoma calidum*, of four congeners listed by Johnson (1930), occurs in this unique heathland as well, but nowhere else on the island, reinforcing concern for the globally rare heath grassland habitat at this site. Although species diversity was relatively high and several unique carabids occurred, numbers here were low.

Permanent water at the Coastal Plains Pond site no doubt led to the observed uniqueness in carabids collected there compared to the Frost Bottom, where no open water remained after early July. Both sites contained a high ground beetle diversity of 22 species each, with only nine common to both. Whereas three *Brachinus* occurred at the Coastal Plains Pond area none were found at the Frost Bottom, underscoring the complex niche requirement of these very host-specific parasites of aquatic beetles.

Another carabid that may need special protection for its habitat on Nantucket is *Agonum darlingtoni*, which turned up sporadically at the Polpis Road cranberry bog area and in sloughs behind Fishers Landing near Eel Point. This rare species, described in 1955, is known only from a restricted area in eastern Canada, a few sites in eastern Massachusetts and Connecticut and one site in New Jersey (Lindroth, 1961–1969). *Stenolophus megacephalus*, another very rare ground beetle described in 1968, shares a similar circumscribed distribution. On Nantucket it was found at

only one site, west of Nantucket town on the south shoreline of Head of Hummock Pond. Both these species are extremely hygrophilous: when pursued they quickly enter the water and hide there in debris.

In addition to the inevitable deleterious physical changes accompanying soaring growth and development pressures on Nantucket, there is a steady shift towards floristic uniformity in the central moors where two aggressive scrub oak species, *ilicifolia* and *prinoides*, have all but eliminated open heath/grassland and savanna vegetational types that were long present historically. This trend towards a *Quercus*-dominated seral climax is well documented by Dunwiddie (1992) in a series of photographs (accompanying a pithy text) that compares late nineteenth and early twentieth century Nantucket landscapes with those of the present.

The influence of floral diversity on ground beetle species richness is manifested by collections made in 1995 in the central moors Oak Barrens site. Here, along a ridge in dense mature *ilicifolia/prinoides* oaks a depauperate ground beetle fauna of only four species occurred, overwhelmingly dominated by *Synuchus impunctatus*, an aggressive newcomer since 1930 with relaxed niche requirements. By contrast, traps at the adjacent Frost Bottom site with much higher phyto-diversity (and moisture regime) yielded a robust 22 species and several co-dominants, plus some uncommon and unique species.

An ongoing program of prescribed burning on Nantucket has opened up the scrub oak climax on the central moors and elsewhere, returning some areas of that landscape to earlier seral stages and higher plant diversity by generating successional mosaics over area and time. Eventually this effort will restore a more varied and ecologically benign set of habitat states to certain parts of the island.

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